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Fast, cheap, variable sensitivity wavefront sensor for applications in communication to microscopy and beyond

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Wavefront sensing is a branch of metrology essential in applications ranging from microscopy, astronomy and optical manufacturing to laser design, free-space communication and ophthalmology. Dominating the industry are the ubiquitously used Shack-Hartmann sensors, which suffer from resolution versus acquisition rate trade offs; as well as inteferometric sensing, which has superb sensitivity but is vulnerable to environmental instability. The transport of intensity equation is an expression of the conservation of energy which relates propagation dynamics of the (easily observable) intensity to the wavefront of an optical field. This technique has been primarily applied in quantitative phase imaging/microscopy where small propagation distances are required to avoid interference effects from diffraction due to sharp phase features. In order to sense small and/or slowly varying wavefronts a larger propagation distance should be considered. We present a wavefront sensor which utilizes holographic propagation using the angular spectrum technique, applied with a micro-mirror device. Additionally, the multiplexing of multiple holograms allows for single shot measurements of intensity gradients over tuneable propagations distances. We demonstrate the effectiveness of the technique in both static, dynamic and adaptive experiments. We believe this will be of value to the larger wavefront sensing community.

Apply to be considered for a student ; award (Yes / No)?

Yes

Level for award;(Hons, MSc, PhD, N/A)?

PhD

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